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Manipulation and size sorting of microparticles in streaming flow

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ABSTRACT

When driven by an acoustic pressure field at ultrasound frequencies, microbubbles adsorbed at a solid boundary establish strong steady vortical flows. Microbubble steady streaming flows represent a unique type of actuating mechanism for microfluidics and have demonstrated great potential in handling micro-objects, controlling liquid transport as well as deforming biological objects (e.g., cells and vesicles). We demonstrate that the geometry of this type of flow can easily be changed interactively and noninvasively, shaping the local flow environment with micron accuracy. Microparticles thus experience tunable forces that alter their trajectories, e.g., depending on their size. Using a combination of bubble streaming and Poiseuille channel flows, we demonstrate devices for size dependent trapping, sorting, and focusing of microparticles. We further emphasize that these streaming flow fields can be described analytically by asymptotic methods, taking much of the guesswork out of the development of new devices.